code are usable to substitute for each single pulse in the basic code. In this way, as long as the received signal passes through a matched filter matched to this pulse compression code in advance, the output is the required LA-CDMA code. Several solutions for increasing pulse duty ratio included in this invention are described below:

Forming an LA-CDMA code by a relative encoding pulse compression method is shown in Figure 6. A positive pulse in the basic LA-CDMA code is generated by two consecutive pulse compression code "B"s with the same polarity, whereas a negative pulse is generated by a positive and a negative pulse compression code "B". For instance, considering a 16-pulse LA-CDMA code with a period of 847, if a 13-bit Barker sequence is chosen for the pulse compression code, then the duty ratio of the code will rise to 16X26/847 (=0.4911).

Forming an LA-CDMA code by an absolute encoding pulse compression method is shown in Figure 7. A positive pulse in the basic LA-CDMA code is generated by a pulse compression code "B", whereas a negative pulse is generated by an inverse (i.e. an inverted polarity "B") of the pulse compression code. For instance, still considering a 16-pulse LA-CDMA code with a period of 847, if a 28-bit pulse compression code is chosen to form a single pulse, then the duty ratio will rise to 16X28/847 (=0.5289); if a 38-bit

pulse compression code is chosen to form a single pulse, then the duty ratio will rise to 16X38/847 (=0.7178).

Adopting a time-offset overlapped method for increasing the duty ratio is illustrated in Figure 8, where "a" is the primitive code, "b", "c", "d" and "e" are shifted code versions after four shifts respectively, and "a+b+c+d+e" is a time-offset overlapped code. It should be noted that the time-offset value must be greater than the time dispersion range of the channel; otherwise, either adding a partial response equalizer to the receiver in order to reduce time dispersion range of channel, or adopting various orthogonal frequencies for the time-offset versions smaller than the time dispersion range of the channel, should be employed. When synchronization techniques are adopted, it is similar to a TDMA technique in that different shift versions can be used by different users. Therefore, this can increase the number of orthogonal codes greatly. In a random access system, each shifted version of the LA-CDMA code can only be used by one user, but that method can increase the user's data rate enormously without expanding system bandwidth, or can decrease system bandwidth while retaining a given data rate.

Clearly, the time-offset overlapped pulse compression method can also be employed, which is a mixture of method 1 and method 2, or a mixture of method 2 and method 3, and

further details are not needed. This method can provide the greatest increase in pulse duty ratio and information rate simultaneously (or decrease system bandwidth with data rate unaffected).

Sometimes it is inconvenient that the maximum number of users offered by the basic LA-CDMA code is determined only by the quantity of basic pulses, since the more orthogonal codes in the code group, the better. Embodiments of this invention may provide three solutions to enlarge the number of users.

The first solution is to adopt orthogonal pulse compression codes. If M pieces of orthogonal pulse compression codes can be found, then MXN orthogonal pulse compression code words can be obtained when there are N pulses in an LA-CDMA code. For example, considering a 16-pulse LA-CDMA code with a period of 847 and choosing a 32-bit orthogonal code as its pulse compression code, as there are 32 orthogonal codes in the 32-bit orthogonal pulse compression code group, there are a total of 16X32 (= 512) orthogonal code words.

The second solution is to adopt orthogonal frequencies. The simplest implementation is to utilize a general purpose FDMA/CDMA mixed technique. In this way, if M kinds of orthogonal frequencies are employed (in which intervals of frequencies are multiples of 1/T, here T is the duration of a pulse in the LA-CDMA code), then MXN